

Workshop on Europa's Icy Shell: Past, Present, and Future

**February 6–8, 2004
Houston, Texas**

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Paul Schenk, *Lunar and Planetary Institute*
Francis Nimmo, *University College, London*
Louise Prockter, *Johns Hopkins University, APL*

— Conveners —

Paul Schenk, Lunar and Planetary Institute
Francis Nimmo, University of London
Louise Prockter, Johns Hopkins University, APL

Lunar and Planetary Institute 3600 Bay Area Boulevard Houston TX 77058-1113

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Preface

This volume contains abstracts that have been accepted for presentation at the workshop on Europa's Icy Shell: Past, Present, and Future, February 6–8, 2004, Houston, Texas.

Administration and publications support for this meeting were provided by the staff of the Publications and Program Services Department at the Lunar and Planetary Institute.

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Program

Friday, February 6, 2004

INTRODUCTION
8:30 a.m. Lecture Hall

Chair: P. M. Schenk

8:30 a.m. Schenk P. M.
Welcoming Remarks

8:40 a.m. McKinnon W. B. * [INVITED]
Overview of Europa's Icy Shell: Questions of Thickness, Composition, Rheology, Tectonics, and Astrobiological Potential [#7048]

COMPOSITION
9:20 a.m. Lecture Hall

Chairs: W. B. McKinnon
R. T. Pappalardo

9:20 a.m. Kargel J. S. * [INVITED]
Composition and Geochemical Evolution of Europa's Icy Shell [#7006]

10:00 – 10:10 a.m. Break

10:10 a.m. McCord T. B. * Orlando T. M. Hansen G. B. Hibbitts C. A.
Hydrated Materials on Europa's Surface: Review of Current Knowledge and Latest Results [#7044]

10:25 a.m. Carlson R. W. *
Distribution of Hydrogen Peroxide, Carbon Dioxide, and Sulfuric Acid in Europa's Icy Crust [#7031]

10:40 a.m. Clark R. N. *
Surface Composition of Europa: Mixed Water, Hydronium, and Hydrogen [#7057]

10:55 a.m. Dalton J. B. * Jamieson C. S. Quinn R. C. Prieto-Ballesteros O. Kargel J.
Highly Hydrated Sulfate Salts as Spectral Analogs to Disrupted Terrains on Europa [#7049]

11:10 a.m. Gomis O. * Satorre M. A. Leto G. Strazzulla G.
Molecules Produced on the Surface of Europa by Ion Implantation in Water Ice [#7002]

11:25 a.m. Moore M. H. Hudson R. L. * Carlson R. W. Ferrante R. F.
Formation and Stability of Radiation Products in Europa's Icy Shell [#7009]

11:40 a.m. Prieto-Ballesteros O. * Kargel J. S. Fernández-Sampedro M. Hogenboom D. L.
Clathrate Hydrates in Jupiter's Satellite Europa and Their Geological Effects [#7010]

11:55 – 12:20 p.m. Discussion

12:20 – 1:30 p.m. Lunch

Friday, February 6, 2004

PHYSICAL PROPERTIES
1:30 p.m. Lecture Hall

Chairs: **S. A. Kattenhorn**
J. R. Spencer

- | | |
|------------------|---|
| 1:30 p.m. | Kohlstedt D. L. * [INVITED]
<i>Deformation of Ice</i> [#7054] |
| 2:00 p.m. | Blankenship D. D. * Morse D. L. [INVITED]
<i>Earth's Ice Sheets and Ice Shelves as an Analog for Europa's Icy Shell</i> [#7053] |
| [Canceled] | Duval P. * Montagnat M.
<i>The Rheology of Ice at Low Stresses; Application to the Behavior of Ice in the European Shell</i> [#7001] |
| 2:25 p.m. | Barr A. C. * Pappalardo R. T.
<i>Numerical Implementation of Ice Rheology for Europa's Shell</i> [#7018] |
| 2:40 p.m. | Nimmo F. *
<i>What is the Young's Modulus of Ice?</i> [#7005] |
| 2:55 p.m. | Sandwell D. T. *
<i>Limits on the Strength of Europa's Icy Shell from Topographic Spectra</i> [#7043] |
| 3:10 – 3:45 p.m. | Break |
| 3:45 p.m. | Turtle E. P. * [INVITED]
<i>What Europa's Impact Craters Reveal: Results of Numerical Simulations</i> [#7020] |
| 4:10 p.m. | Phillips C. B. * Chyba C. F.
<i>Impact Gardening, Sputtering, Mixing, and Surface-Subsurface Exchange on Europa</i> [#7036] |
| 4:25 p.m. | Spencer J. R. * [INVITED]
<i>Thermal Properties of Europa's Ice Shell</i> [#7040] |
| 4:50 p.m. | Eluszkiewicz J. *
<i>Assessing Porosity Structure in Europa's Crust</i> [#7014] |
| 5:05 – 5:35 p.m. | Discussion |

Friday, February 6, 2004

POSTERS
5:40 p.m. Great Room

Konesky G. A.

Can the Electronic Tongue be Given a Taste for Life? [#7007]

Lipps J. H.

Europa's Icy Crust as a Habitat and Repository of Life [#7015]

Myrick T. Frader-Thompson S. Wilson J. Gorevan S.

Development of an Inchworm Deep Subsurface Platform for in Situ Investigation of Europa's Icy Shell [#7041]

Cooper J. F. Johnson R. E. Waite J. H.

Remote Sensing of Europa Surface Composition with Ions, Neutral Atoms, and X-Rays in the Local Space Environment [#7019]

Biele J. Ulamec S. Parpart A.

Melting Probe Tests in Thermal Vacuum [#7013]

Wurz P. Rohner U. Whitby J. A.

A Highly Miniaturised Laser Ablation Time-of-Flight Mass Spectrometer for Planetary Exploration [#7003]

Collier M. R. Sittler E. Chornay D. Cooper J. F. Coplan M. Johnson R. E.

Remote Sensing of Icy Galilean Moon Surface and Atmospheric Composition Using Low Energy (1 eV–4 keV) Neutral Atom Imaging [#7022]

Hand K. P. Carlson R. W. Chyba C. F.

Empirical Determination of Radiolytic Products in Simulated Europan Ices [#7029]

Markus T. Gogineni S. P. Green J. L. Fung S. F. Cooper J. F. Taylor W. W. L. Garcia L.

Reinisch B. W. Song P. Benson R. F. Gallagher D.

Surface Penetrating Radar Simulations for Europa [#7016]

Crawford Z. A. Pappalardo R. T. Collins G. C.

Creating a Georeferenced Digital Image Library of Europa [#7035]

Schenk P. Moore J. M.

High-Resolution Mapping of Europa's Impact Craters: Comparison with Ganymede [#7051]

Qin R. Buck W. R. Pappalardo R. T.

Europan Bands Formed by Stretching the Icy Crust: A Numerical Perspective [#7030]

Kereszturi A.

Implication on Possible Submarin Biosignatures at Chaotic Terrains [#7011]

Saturday, February 7, 2004

AGES AND STRATIGRAPHY
8:30 a.m. Lecture Hall

- Chairs: E. P. Turtle
P. E. Geissler
- 8:30 a.m. Zahnle K. * Schenk P. Dones L. Levison H. [INVITED]
Cratering Rates in the Jovian System [#7052]
- 8:55 a.m. Prockter L. M. * Figueredo P. H. [INVITED]
Geological Features and Resurfacing History of Europa [#7056]
- 9:35 a.m. Schenk P. M. *
Sinking to New Lows & Rising to New Heights: The Topography of Europa [#7046]

10:15 – 10:35 a.m. Break

TIDAL DEFORMATION
10:35 a.m. Lecture Hall

- Chairs: P. E. Geissler
E. P. Turtle
- 10:35 a.m. Moore W. B. * [INVITED]
Tidal Deformation and Tidal Dissipation in Europa [#7055]
- 11:05 a.m. Bills B. G. *
Long Period Variations in Tidal and Librational Forcing of Europa [#7025]
- 11:20 a.m. Figueredo P. H. * [INVITED]
Geological Constraints on Tidal and Rotational Deformation on Europa [#7045]
- 11:50 a.m. Kattenhorn S. A. *
What is (and Isn't) Wrong with Both the Tension and Shear Failure Models for the Formation of Lineae on Europa [#7023]
- 12:05 p.m. Marshall S. T. * Kattenhorn S. A.
Analysis of Europan Cycloid Morphology and Implications for Formation Mechanisms [#7026]

12:20 – 12:50 p.m. Discussion

12:50 – 1:50 p.m. Lunch

Saturday, February 7, 2004

THERMAL EVOLUTION AND TECTONICS
1:50 p.m. Lecture Hall

Chairs:	A. P. Showman P. H. Figueiredo
1:50 p.m.	Nimmo F. * [INVITED] <i>Lateral and Vertical Motions in Europa's Ice Shell [#7004]</i>
2:20 p.m.	Hussmann H. * Spohn T. <i>Europa's Ice Shell Thickness Derived from Thermal-Orbital Evolution Models [#7012]</i>
2:35 p.m.	Sotin C. * Choblet G. Head J. W. Mocquet A. Tobie G. <i>Thermal Evolution of Europa's Icy Crust [#7017]</i>
2:50 p.m.	Stempel M. M. * Barr A. C. Pappalardo R. T. <i>Constraints on the Opening Rate of Bands on Europa [#7027]</i>
3:05 p.m.	Manga M. * Sinton A. <i>Wax Models of Europan Tectonics [#7008]</i>
3:20 p.m.	Patterson G. W. * Head J. W. III <i>Numerical Modeling of Plate Motion: Unraveling Europa's Tectonic History [#7038]</i>
3:35 – 3:55 p.m.	Break
3:55 p.m.	Geissler P. E. * [INVITED] <i>Origin of Chaos Terrain [#7050]</i>
4:25 p.m.	Tobie G. * Choblet G. Lunine J. Sotin C. <i>Interaction Between the Convective Sublayer and the Cold Fractured Surface of Europa's Ice Shell [#7033]</i>
4:40 p.m.	Pappalardo R. T. * Barr A. C. <i>Domes on Europa: The Role of Thermally Induced Compositional Diapirism [#7047]</i>
4:55 p.m.	Zolotov M. Yu. * Shock E. L. Barr A. C. Pappalardo R. T. <i>Brine Pockets in the Icy Shell on Europa: Distribution, Chemistry, and Habitability [#7028]</i>
5:10 – 5:40 p.m.	Discussion
6:00 p.m.	Dinner in Galveston via bus (advance reservations required)

Sunday, February 8, 2004

OCEANS AND EXPLORATION
8:30 a.m. Lecture Hall

Chairs:	G. C. Collins D. D. Blankenship
8:30 a.m.	Makris N. C. * Lee S. Pappalardo R. T. <i>Probing Europa's Interior with Natural Sound Sources</i> [#7024]
8:45 a.m.	Peters M. E. * Blankenship D. D. Morse D. L. <i>Radar Sounding Studies for Quantifying Reflection and Scattering at Terrestrial Air-Ice and Ice-Ocean Interfaces Relevant to Europa's Icy Shell</i> [#7034]
9:00 a.m.	Winebrenner D. P. * Blankenship D. D. Campbell B. A. <i>Physical Basis for the Radar Observation of Geological Structure in the Ice Shell on Europa</i> [#7037]
9:15 a.m.	Vance S. D. * Brown J. M. Spohn T. Shock E. <i>Subsurface Action in Europa's Ocean</i> [#7039]
9:30 a.m.	Collins G. C. * Goodman J. C. <i>Hydrothermal Plumes and Heating Europa's Ice Shell from Below</i> [#7032]
9:45 a.m.	Niebur C. * [INVITED] <i>JIMO Status</i>
10:00 – 10:20 a.m.	Break

PANEL DISCUSSION
10:20 a.m. Lecture Hall

Chair:	G. Schubert
10:20 a.m.	Johnson T. V. McKinnon W. B. Melosh H. J. Moore J. M. Schubert G. <i>Experts (Graybeard) Panel and Workshop Discussions</i>
11:45 a.m.	Closing Remarks